

Preparation for AIRS Validation

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Topics

- MODIS Workshop announcement
- UW AIRS Validation Activities
 - ARM Best Estimate status
 - AFWEX (ARM site validation)
 - Land Surface Emissivity

Cloud Mask

- MODIS Cloud Mask Workshop
- May 8-9, 2001 at UW-Madison hosted by Steve Ackerman
- AIRS team representative is invited to participate
- Focus is on assisting users of the MODIS cloud mask.

UW AIRS Validation Activities

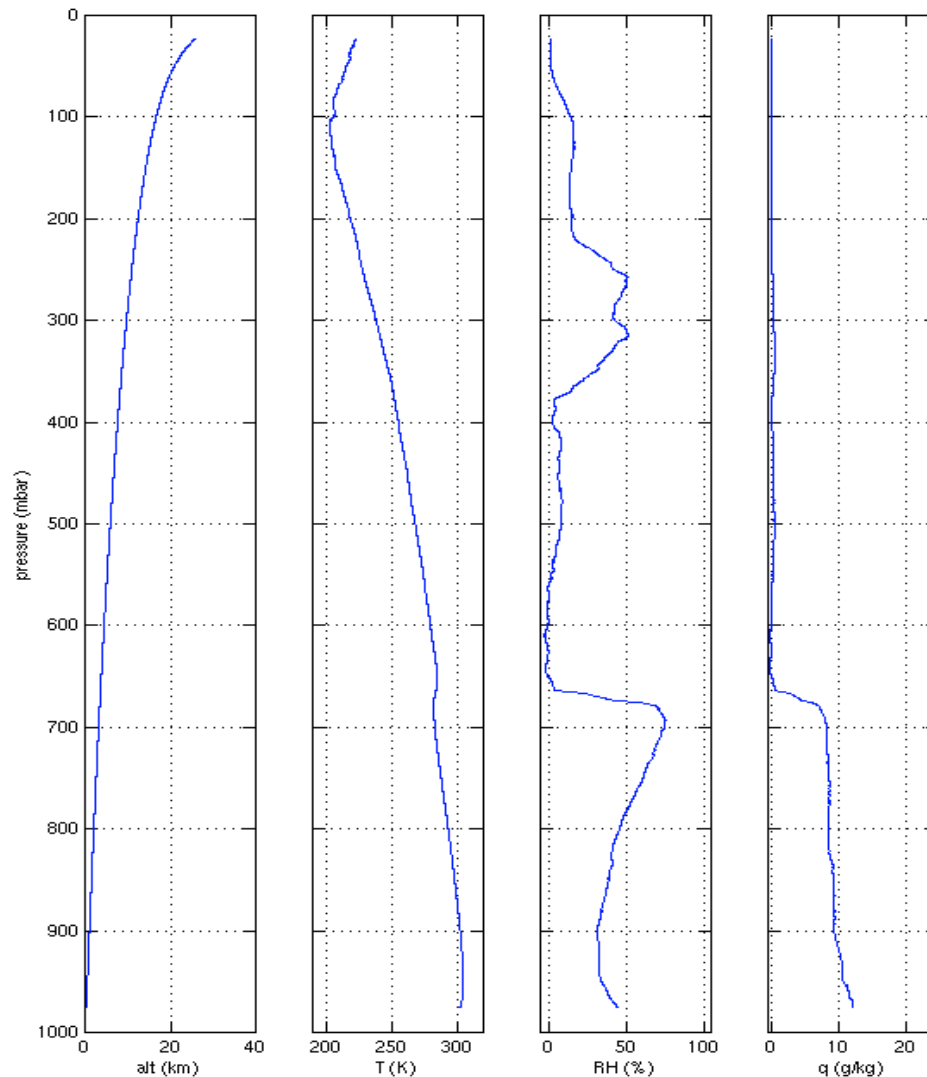
- ARM Temperature & Water Vapor
- Radiance
 - ARM
 - Aircraft
 - MODIS / CERES
- Surface Temperature
 - SST
 - LST

AIRS ARM Atmospheric State Best Estimate

Example Quicklook Image

Best estimate profiles

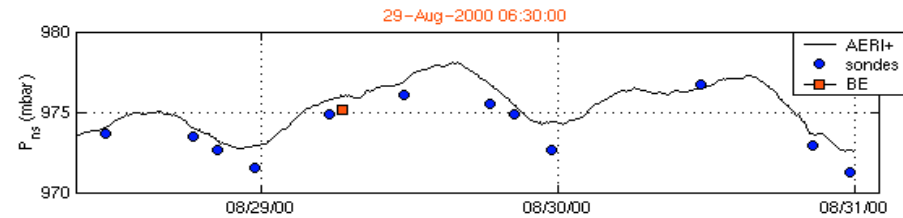
- pressure
- temperature
- relative humidity
- water vapor mixing ratio



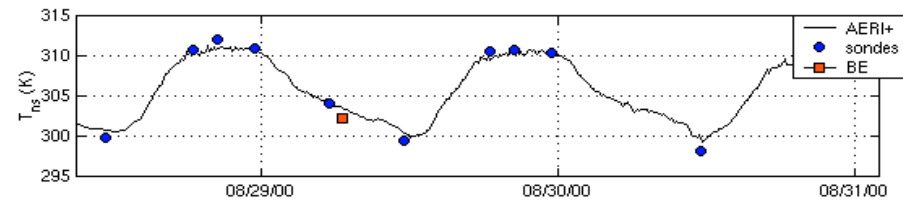
AIRS ARM Atmospheric State Best Estimate

Example Quicklook Image

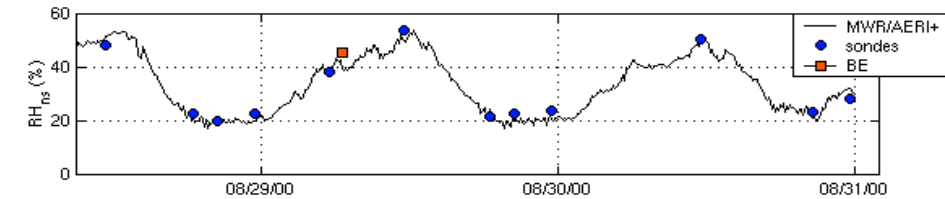
air pressure



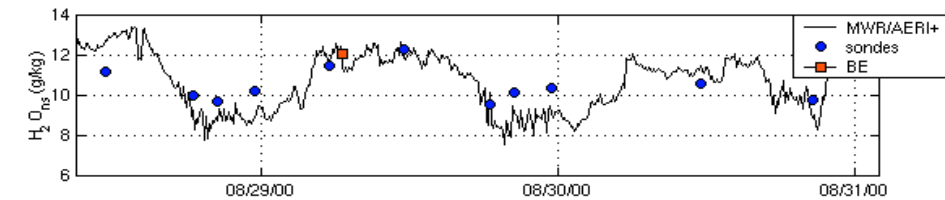
air temperature



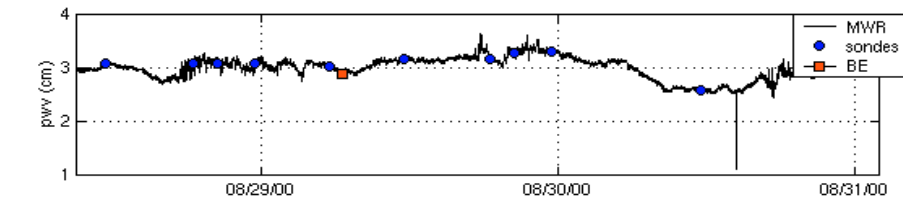
relative humidity



water vapor mixing ratio

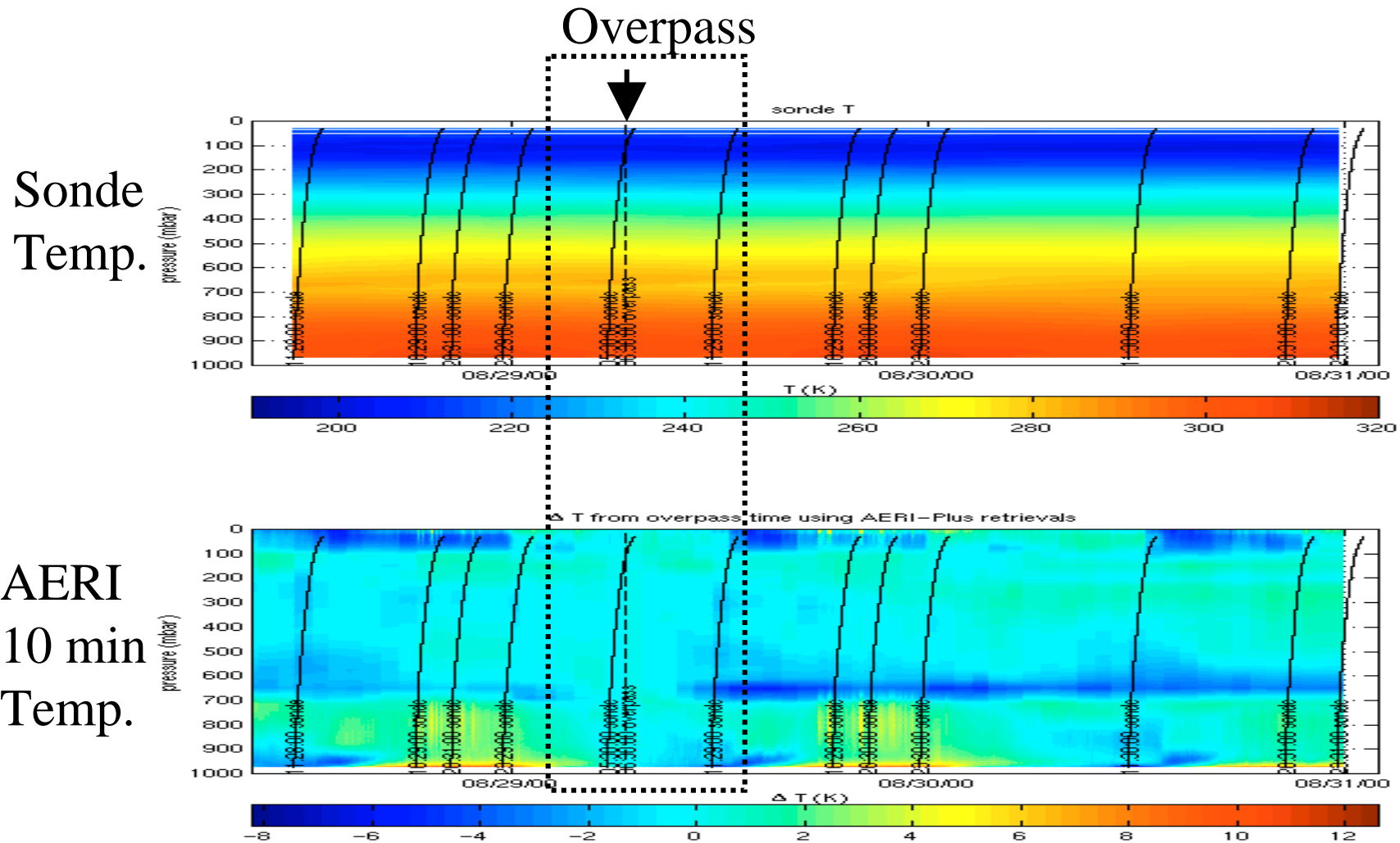


integrated column water vapor



AIRS ARM Atmospheric State Best Estimate

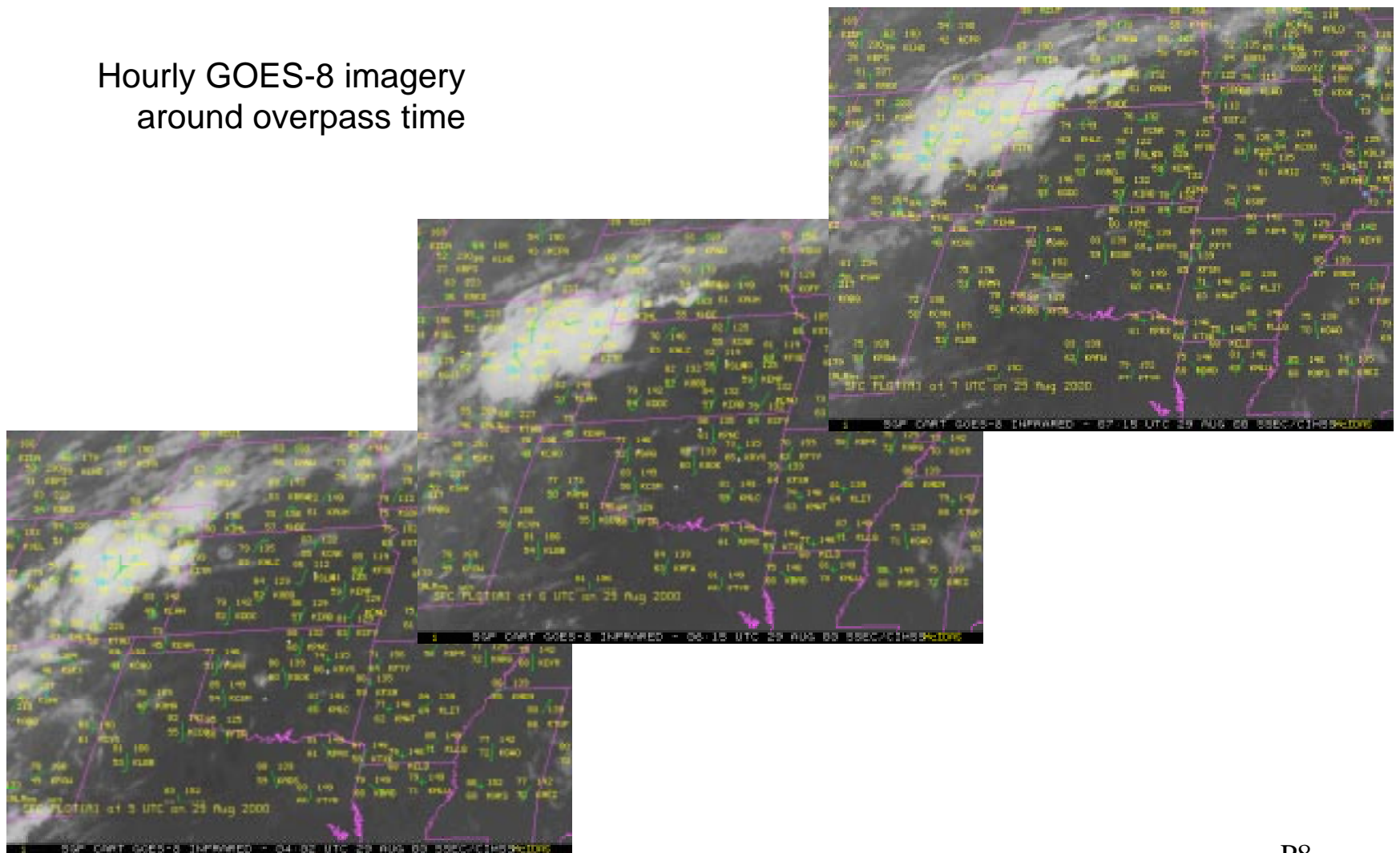
Example Quicklook Image



AIRS ARM Atmospheric State Best Estimate

Example Quicklook Image

Hourly GOES-8 imagery
around overpass time



AIRS ARM Atmospheric State Best Estimate Status

AIRS STM, 20-22 Feb 2001

Algorithm Status:

- Fetches required SGP data
- Produces pressure, temperature, and water vapor profiles and their uncertainties for an input overpass time
- Produces a NetCDF file and quicklook images
- Sample files available from <ftp://tyler.ssec.wisc.edu/pub/outgoing/airs/>

To Do:

- Produce profiles representative of the AMSU footprint by taking larger scale spatial gradients within the footprint into account using GOES and model data
- Modify upper level radiosonde water vapor profiles based on sonde/Raman Lidar comparisons
- Automation
- Test with MODIS TERRA overpasses
- Implement for NSA and TWP site

ARM-FIRE Water Vapor Experiment (AFWEX)

SGP ARM CART Site, November/December 2000

<http://arm1.ssec.wisc.edu/~data/exper/afwex/>

Objectives:

Use of the DOE Atmospheric Radiation Measurement (ARM) facilities to assess accuracy limitations of sondes for upper level water vapor measurements (8-12 km) and calibrate/validate Raman lidar as a key future satellite validation tool.

- Establish the calibration accuracy of the ARM site RAMAN LIDAR with LASE and in-situ sensors on the NASA DC8 aircraft.
- Characterization of the ***absolute accuracy of ARM site radiosondes***.
- Measurement of coincident upwelling infrared radiation with the UW Scanning-HIS, the NPOESS Atmospheric Sounder Testbed (NAST-I and NAST-M), and the FIRSC.
- Ground-based observations of surface radiative temperature and emissivity.
- Compilation of ***clear sky validation case studies*** for forward model and retrieval studies.
- Observation of thick cirrus and its signature in the far-infrared and millimeter wave spectral regions

AFWEX Participants

- **Ground Based Sensors** (ARM SGP Central Facility)
 - microwave radiometer, Raman Lidar, GPS, tower and ground-based in-situ sensors, AERI, ... (standard ARM)
 - an additional ground-based Raman Lidar (GSFC SRL)
 - 3-hourly Vaisala RS-80 radiosondes (ARM)
 - a ground-based Differential Absorption Lidar system (MPIDIAL)
 - chilled mirror and VIZ radiosondes (NASA WFF)
- **DC-8**
 - zenith and nadir viewing DIAL system (NASA LaRC LASE)
 - in-situ cryogenic dew/frost-point hygrometer (NASA LaRC CRYO)
 - in-situ tunable diode laser water vapor absorption system (NASA LaRC TDL)
 - an infrared spectrometer (UW Scanning-HIS)
 - in-situ sensors of CH₄, CO, CO₂, O₃, and temperature (NASA LaRC COAST)
- **Proteus**
 - a high spectral resolution infrared sounder (NAST-I)
 - a microwave spectrometer (NAST-M)
 - a millimeter-wave/far-infrared spectrometer (FIRSC)



AFWEX Operations

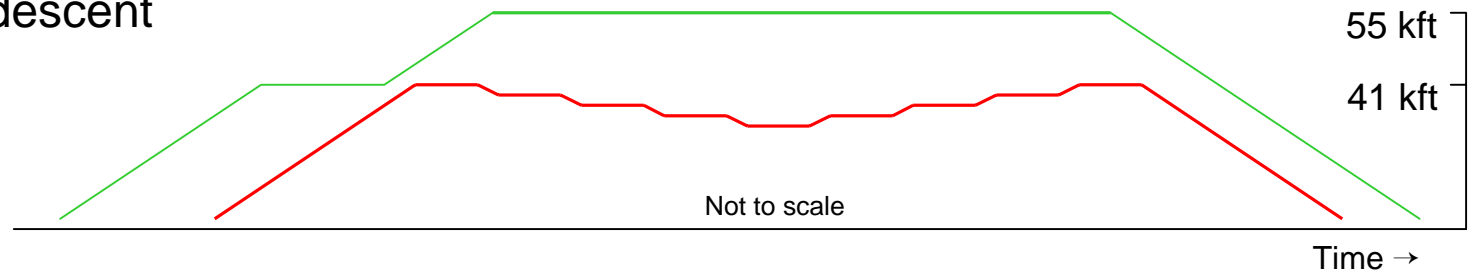
• Typical Flight Plan

• Proteus

- spiral ascent to 41 kft
- mapping pattern at 41 kft
- spiral ascent to 55 kft
- mapping pattern at 55kft
- spiral descent

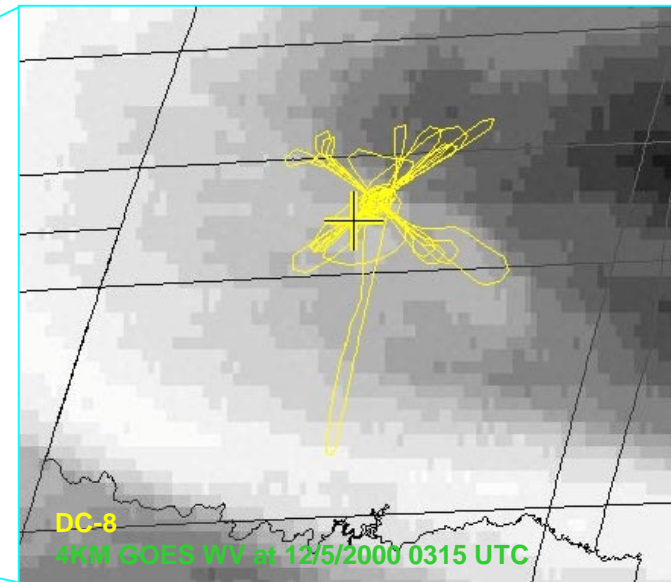
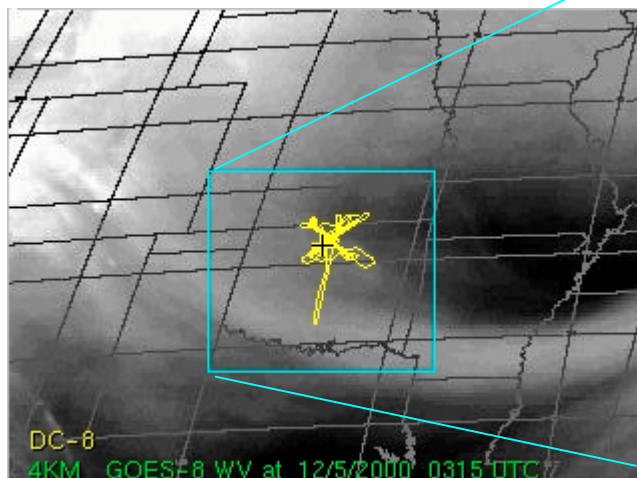
• DC-8

- spiral ascent to 41 kft
- level legs at 41, 35, 31, 28, 25kft
- spiral descent



• Example DC-8 flight track

12/5/2000



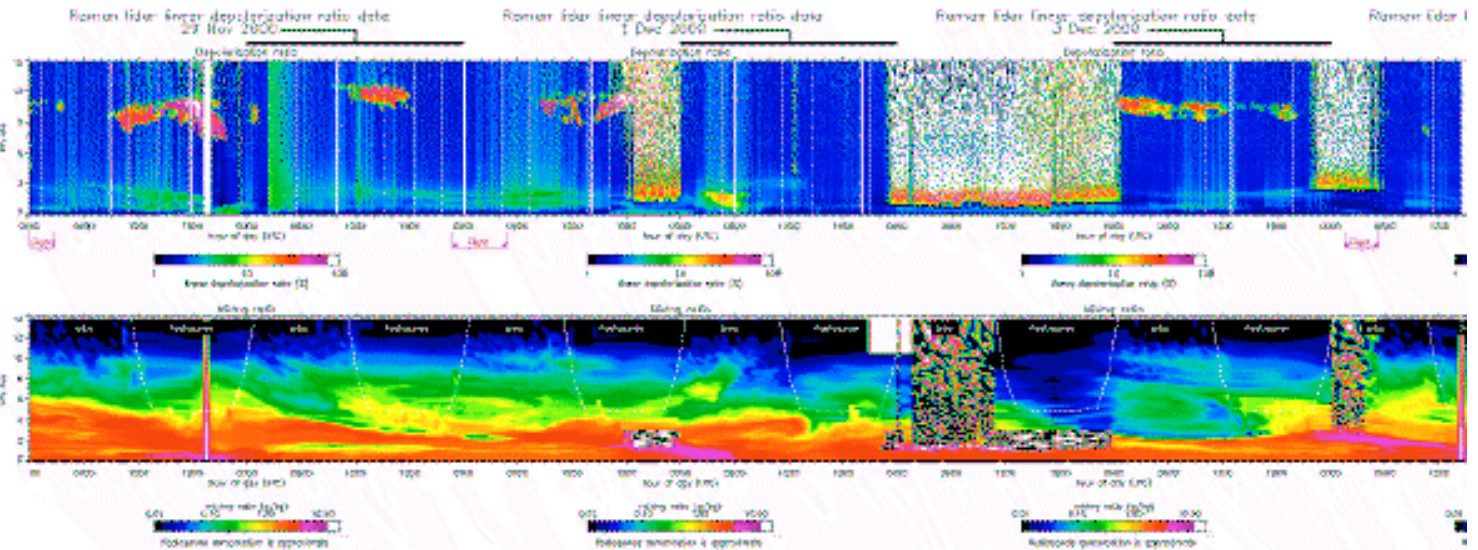
Flight Summary

- CART Raman Lidar (CRL) and radiosonde time series**

CRL depolarization

11/27-12/4

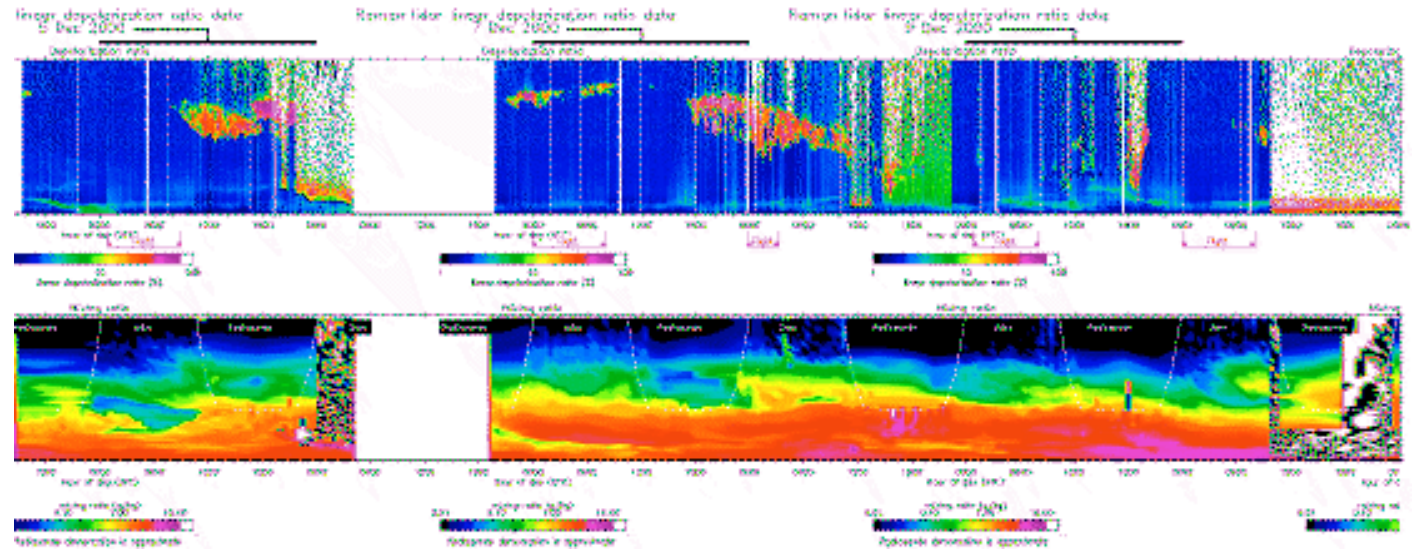
CRL water vapor
(+ upper level from
sondes during the day)

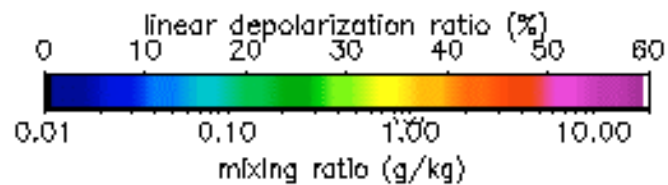
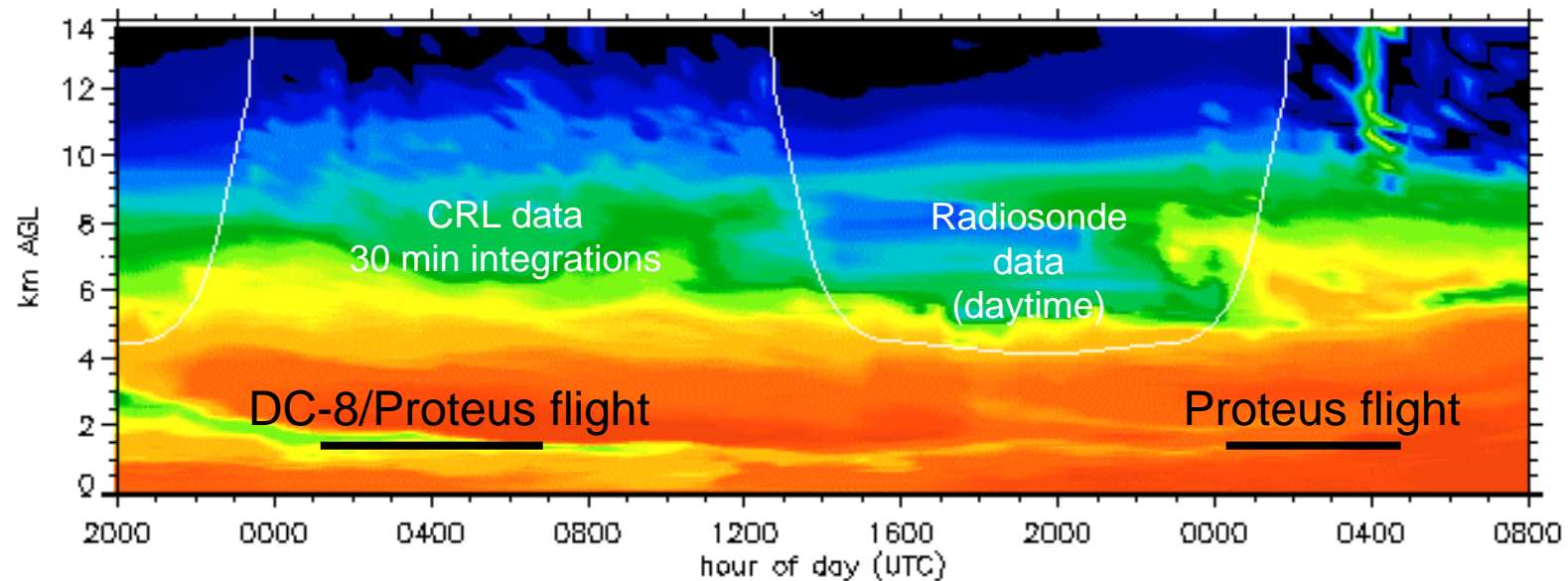
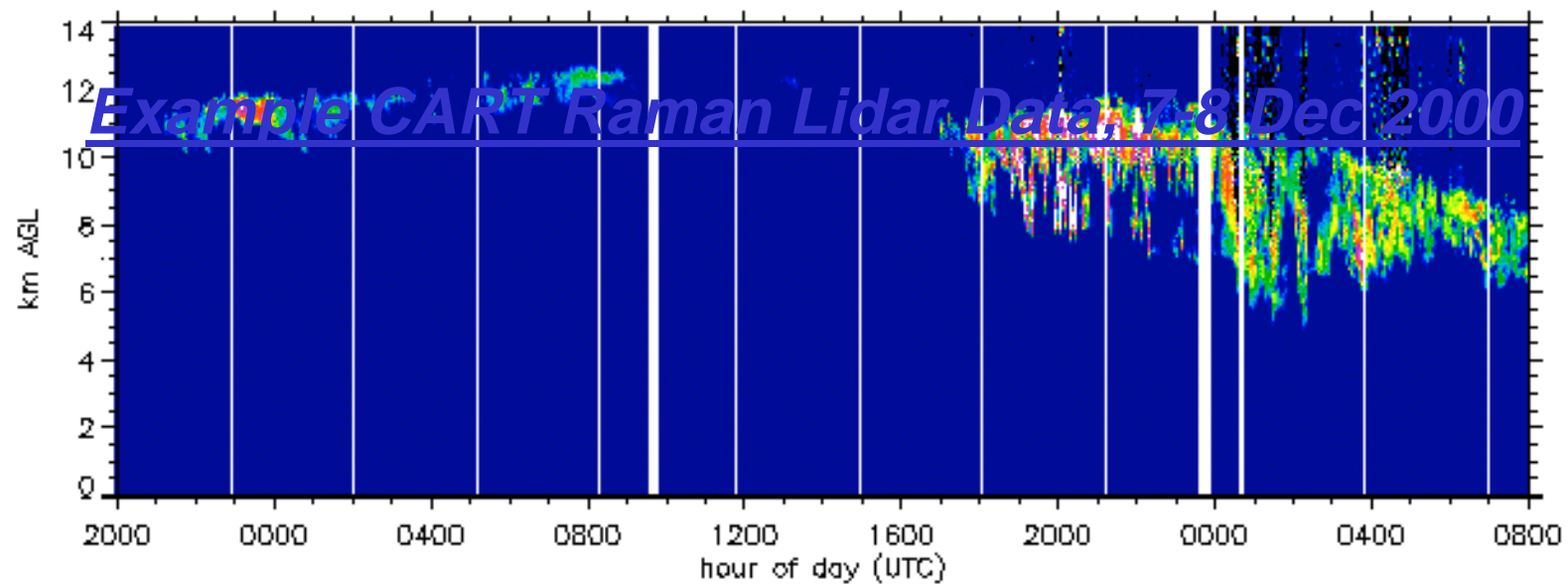


CRL depolarization

12/5-12/9

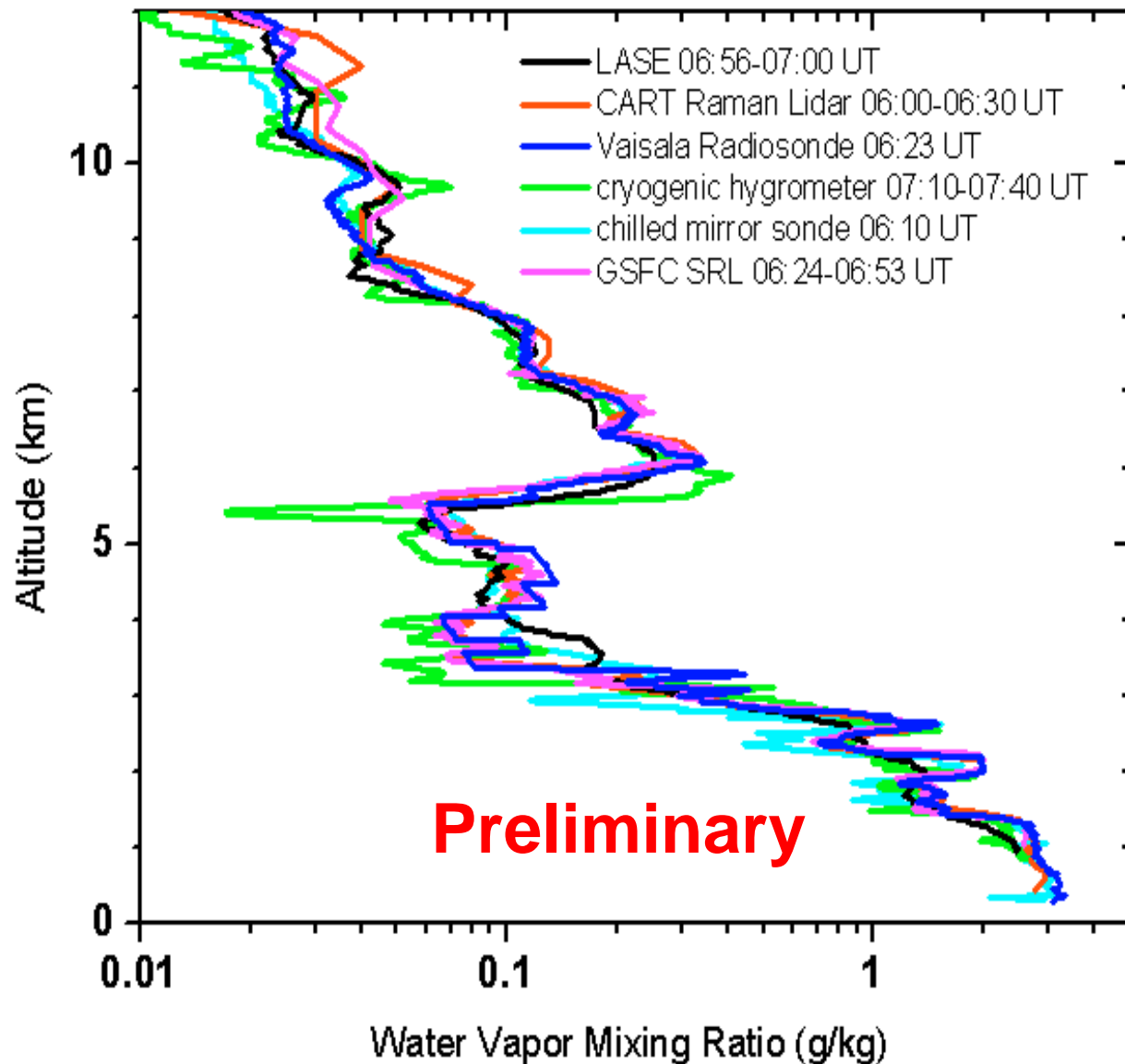
CRL water vapor
(+ upper level from
sondes during the day)





Example Upper Level Water Vapor Intercomparison

Radiosonde/ Raman Lidar/ Raman Lidar/ chilled mirror sonde/LASE/in-situ hygrometer. AFWEX, 5 Dec. 2000.



LASE (Lidar Atmospheric Sounding Expt) on DC8

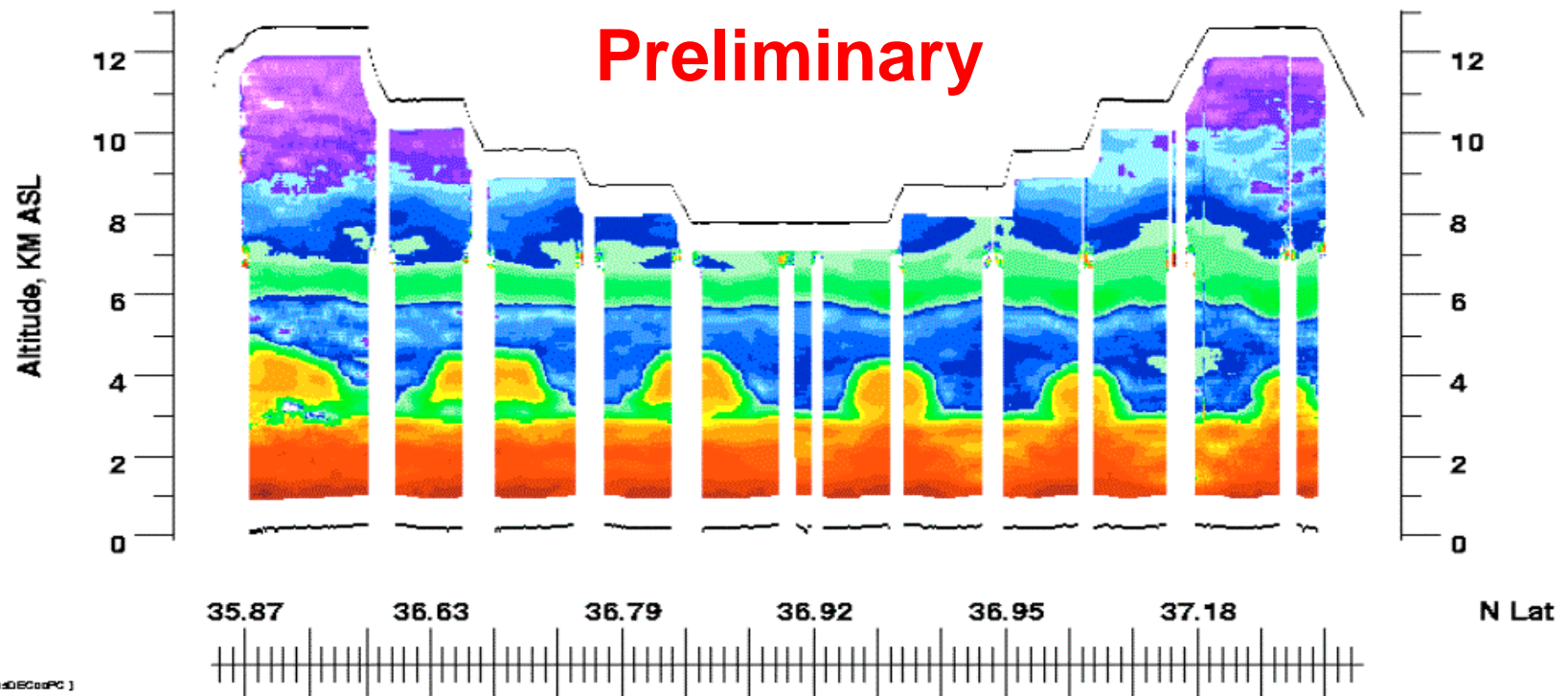
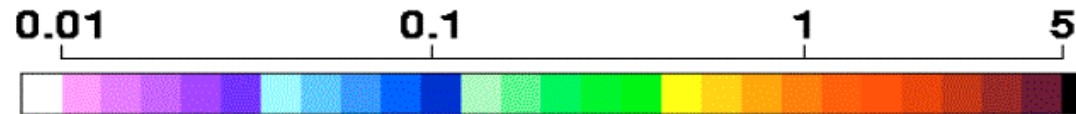
CART Site Flight 1

LASE/AFWEX

Flight 7

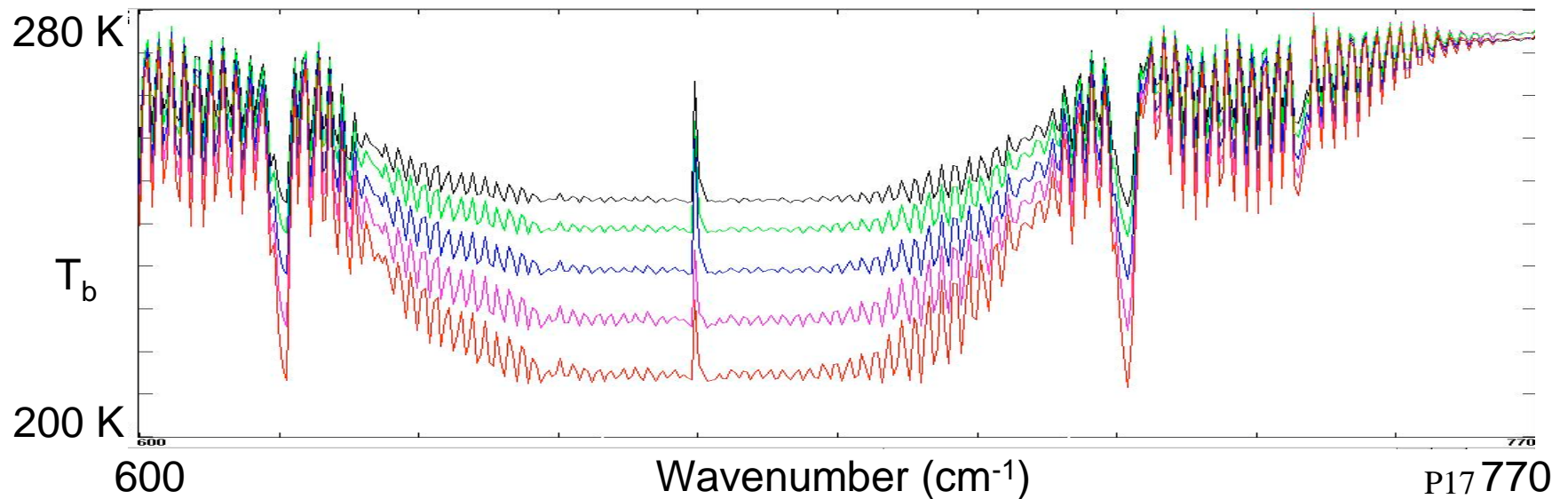
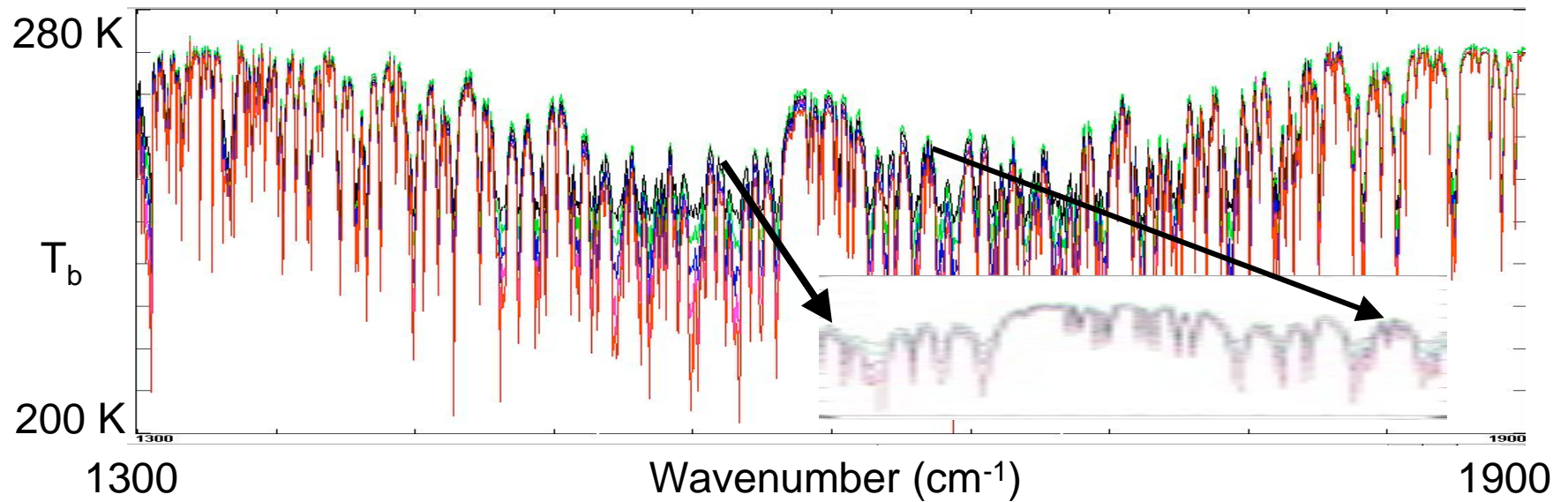
5 Dec 00

Water Vapor Mixing Ratio (g/kg)



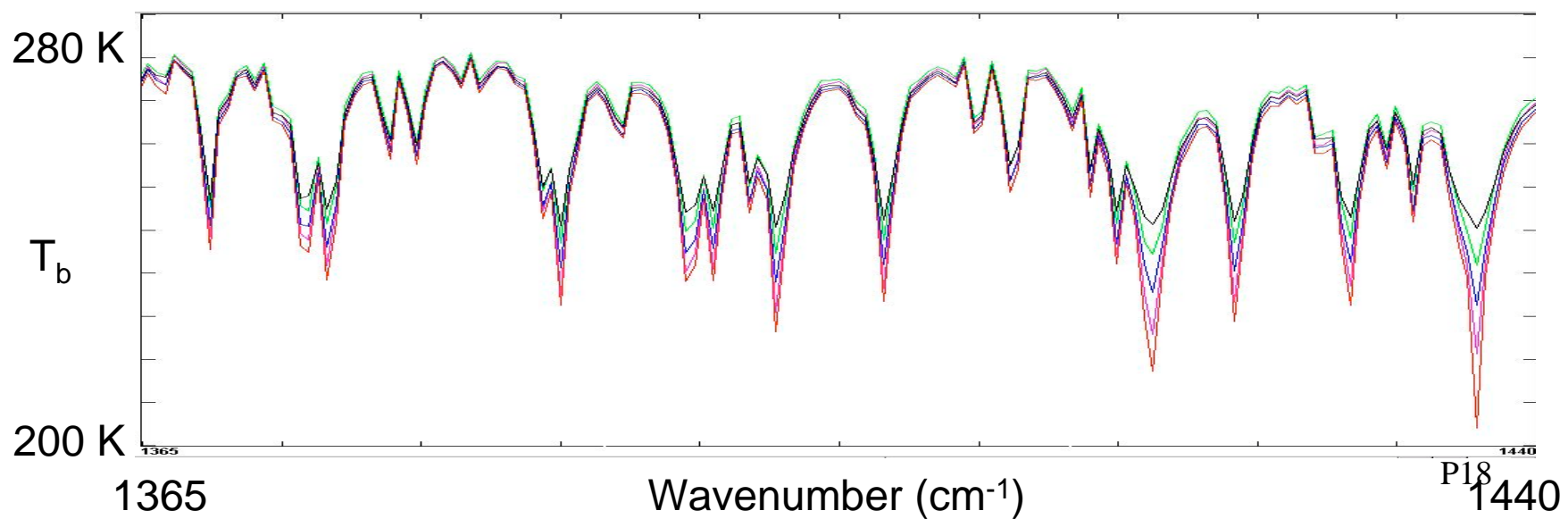
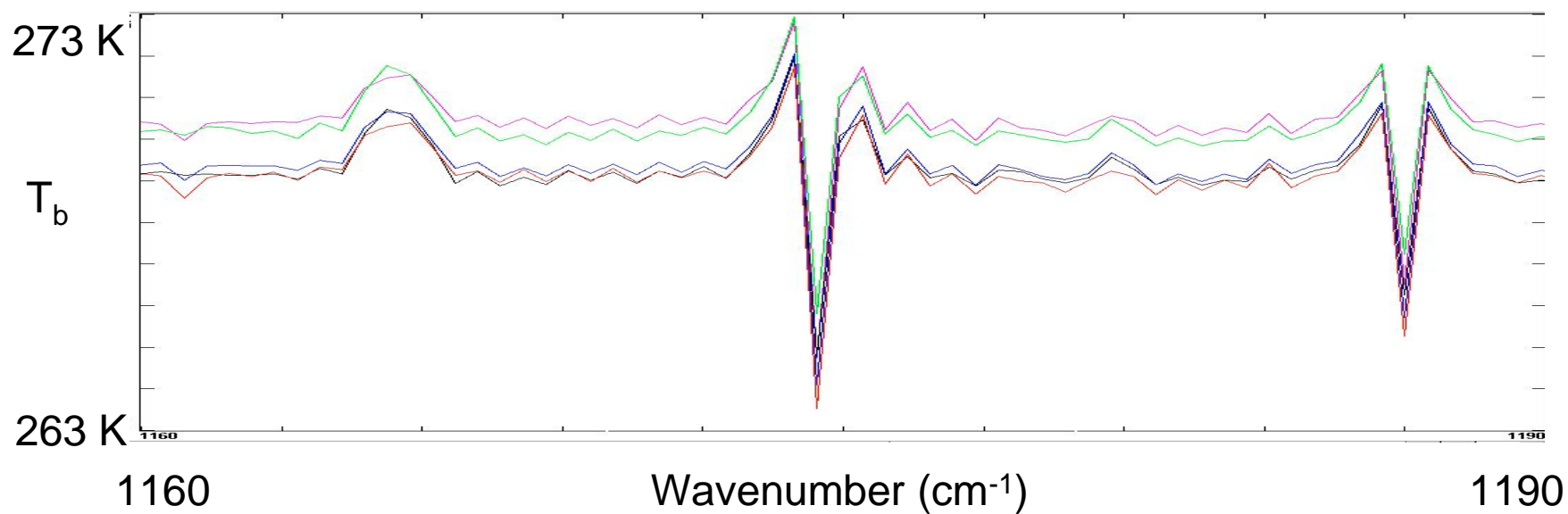
Scanning HIS Spectra from DC8: 5 level legs

8-13 km, 29 Nov 2000

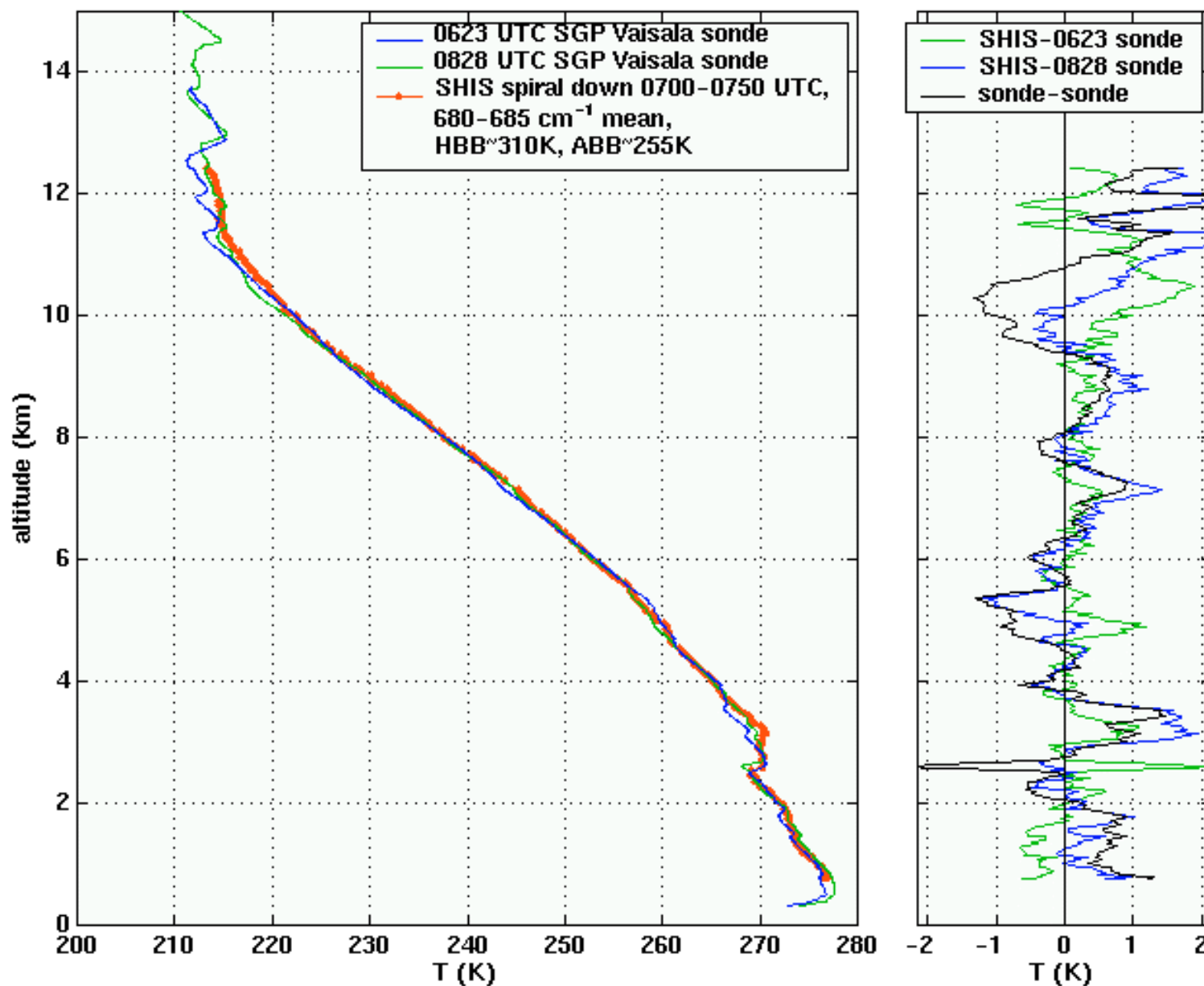


Scanning HIS Spectra from DC8: 5 level legs

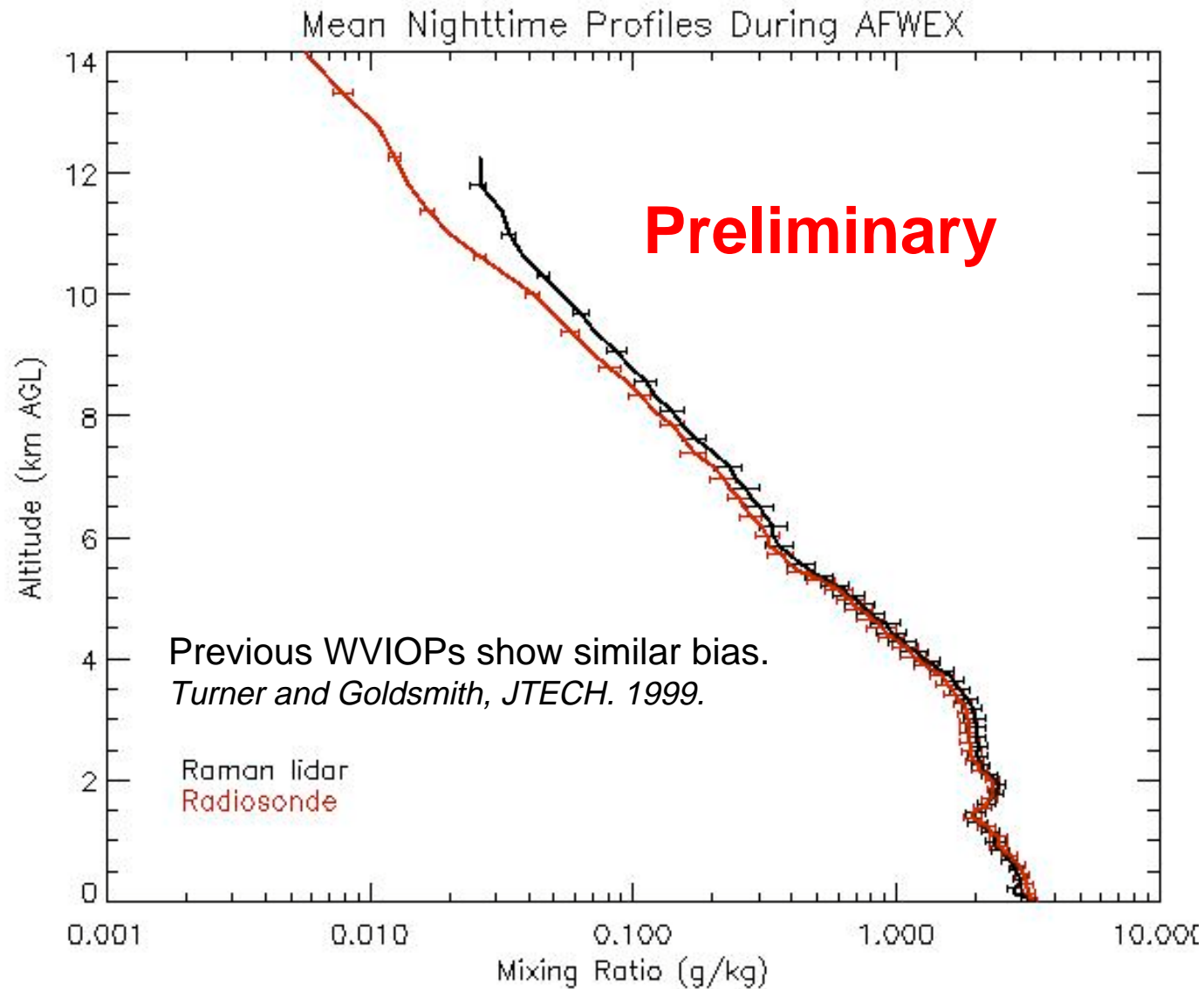
8-13 km, 29 Nov 2000



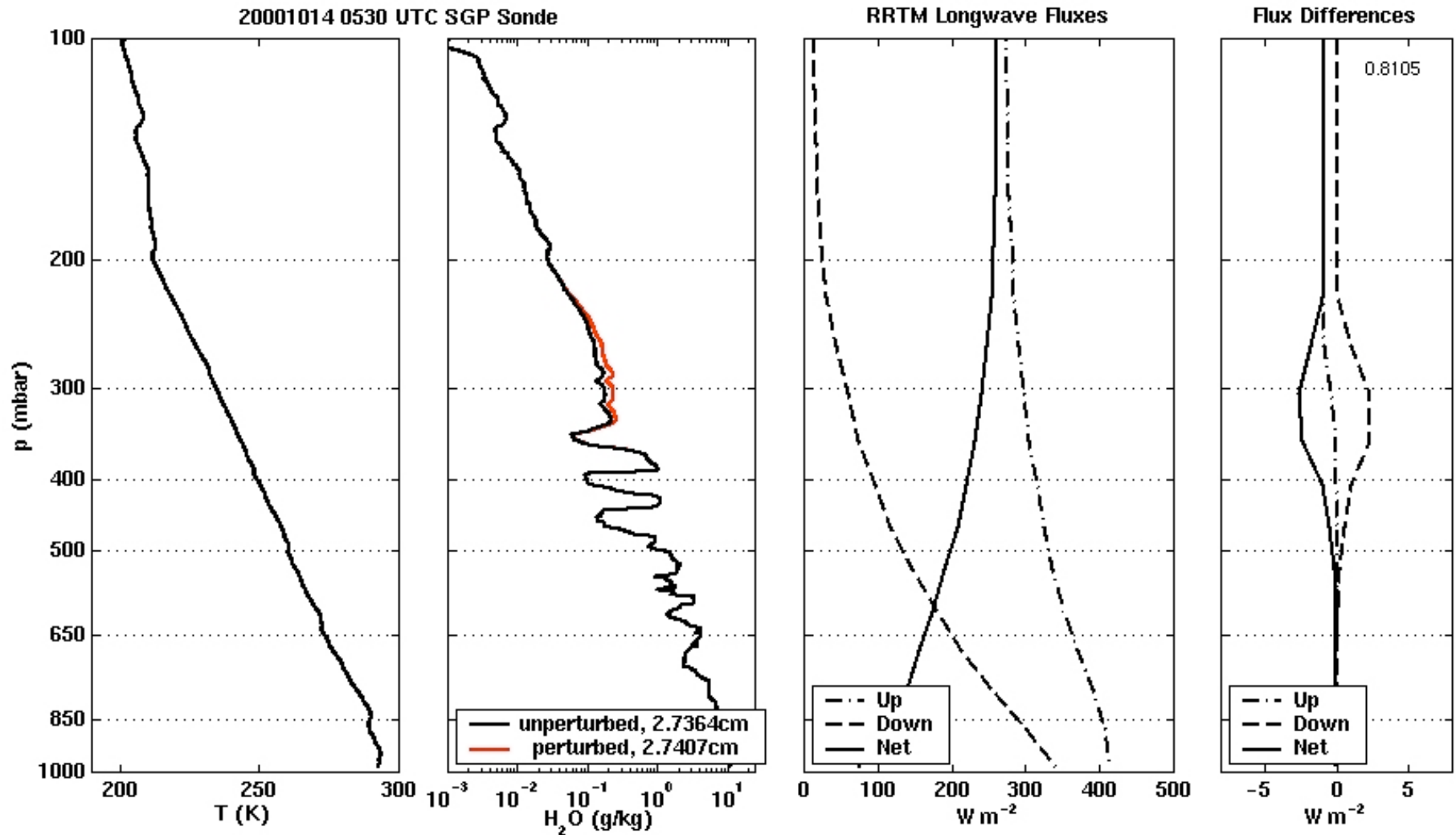
Temperature profiles: radiosondes and derived from opaque CO₂ regions of S-HIS spectra during a spiral descent. 5 Dec 2000



Preliminary ARM Raman Lidar / Radiosonde Comparison



Effect on OLR; example for a typical AFWEX sonde profile
8-12 km water vapor increased by ~30%; TOA Flux: -0.8 W/m²



ARM Land Surface Temperature & Emissivity

AIRS STM, 20-22 Feb 2001

Objectives:

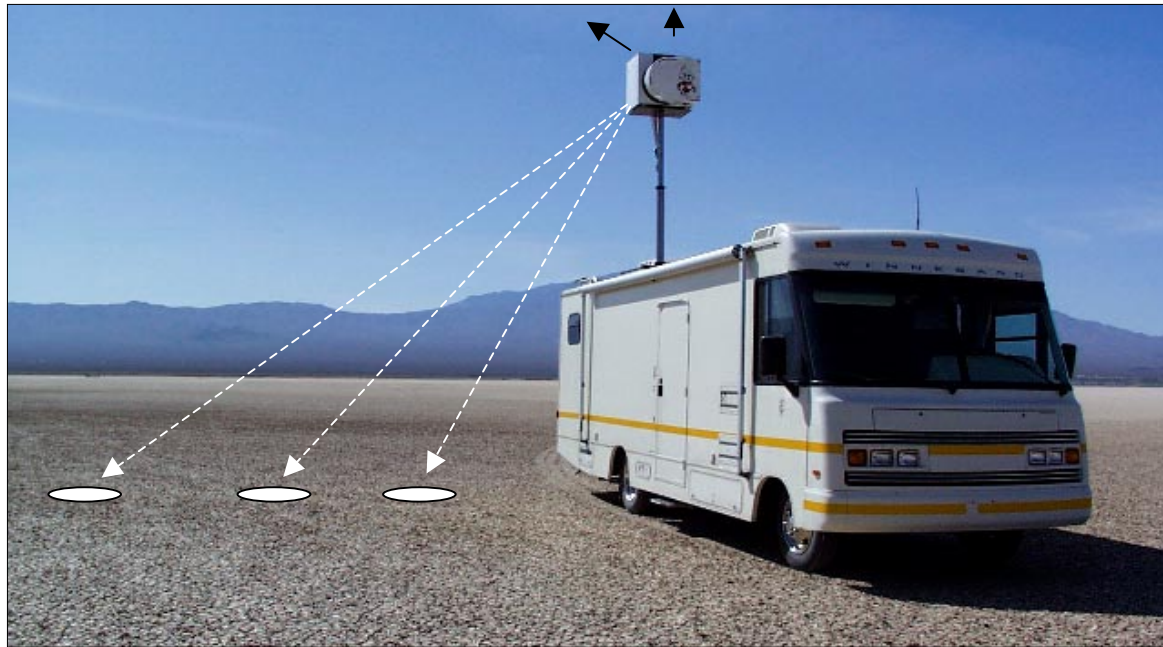
- Characterize the land surface emissivity characteristics of the DOE ARM site in order to improve the radiance validation potential of this location.
- Demonstrate the use of MODIS data to characterize subpixel temperature variations.
- Develop a global dataset of land surface emissivity measurements.

Accomplishments:

- Collaboration with MASTER science team (Simon Hook, et al.)
- PhD Thesis of Nick Bower completed on land surface emissivity measurements. (Curtin University under Merv Lynch)
- Selected case studies provided to AIRS science team.
- ARM site survey conducted during AFWEX (November 2000).
- Investigation of IMG data for use in developing a global dataset.

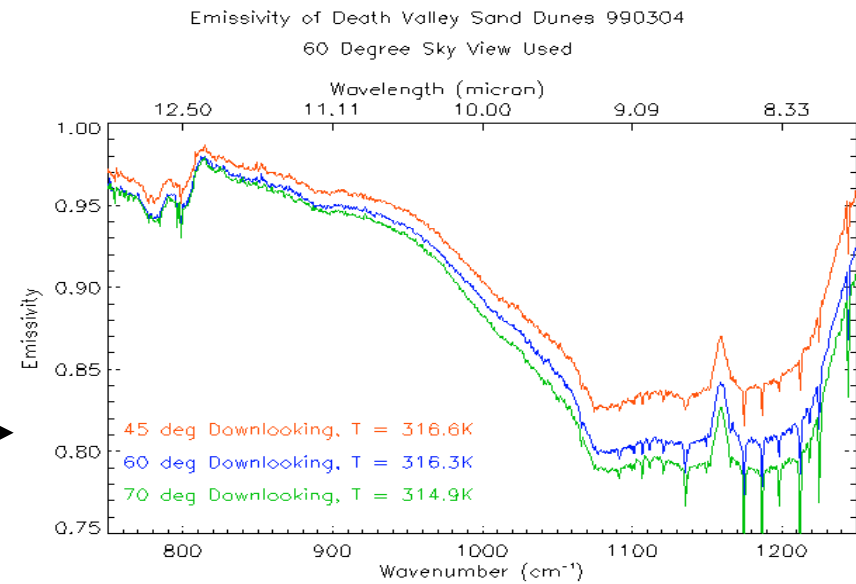
Surface AERI (Atmospheric Emitted Radiance Interferometer)

- Surface and Atmospheric Emitted Radiance Interferometer.
- 0.5 cm^{-1} resolution over $3.3 - 18 \text{ mm}$.

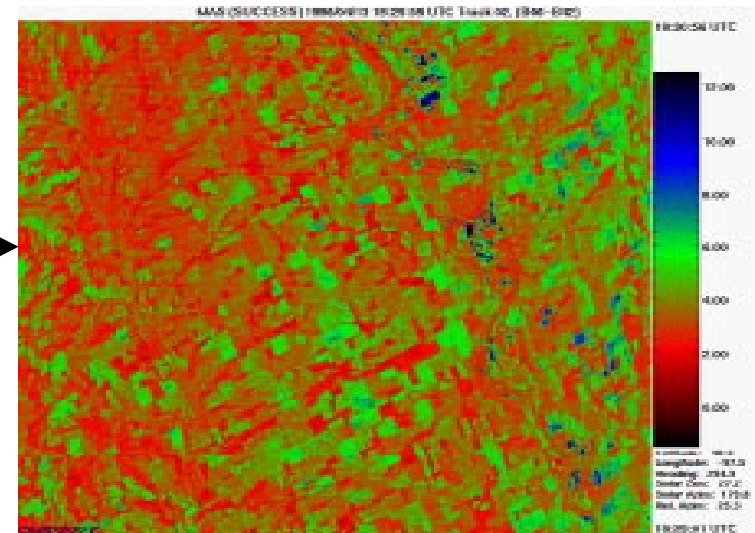
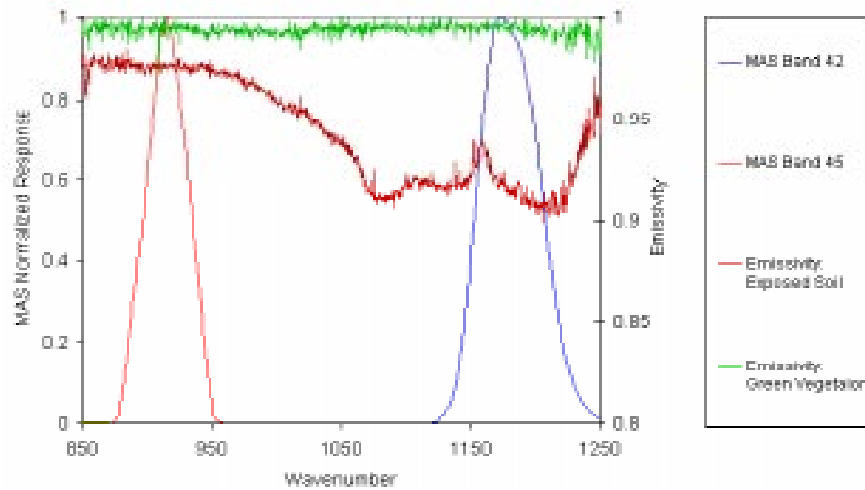




Quartz
Signal
of pure
Sand



MAS Bands 42 and 45 for Identifying Agricultural Land Use



ARM Site Variability: MAS Band 45 - 42

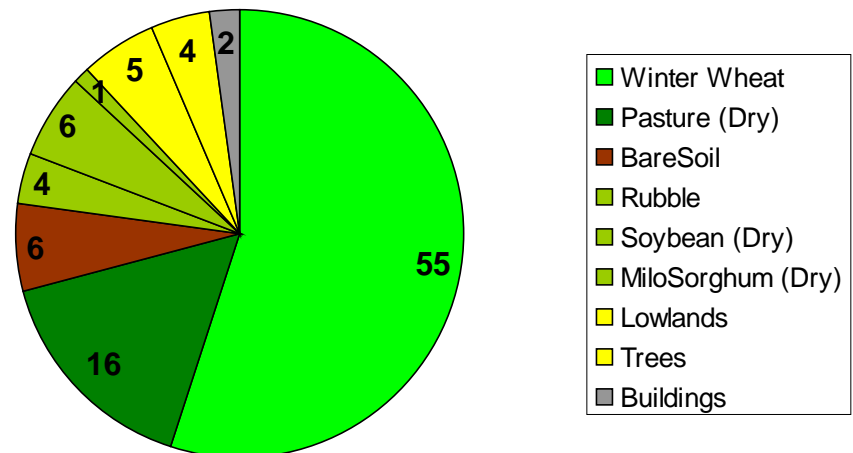
P24

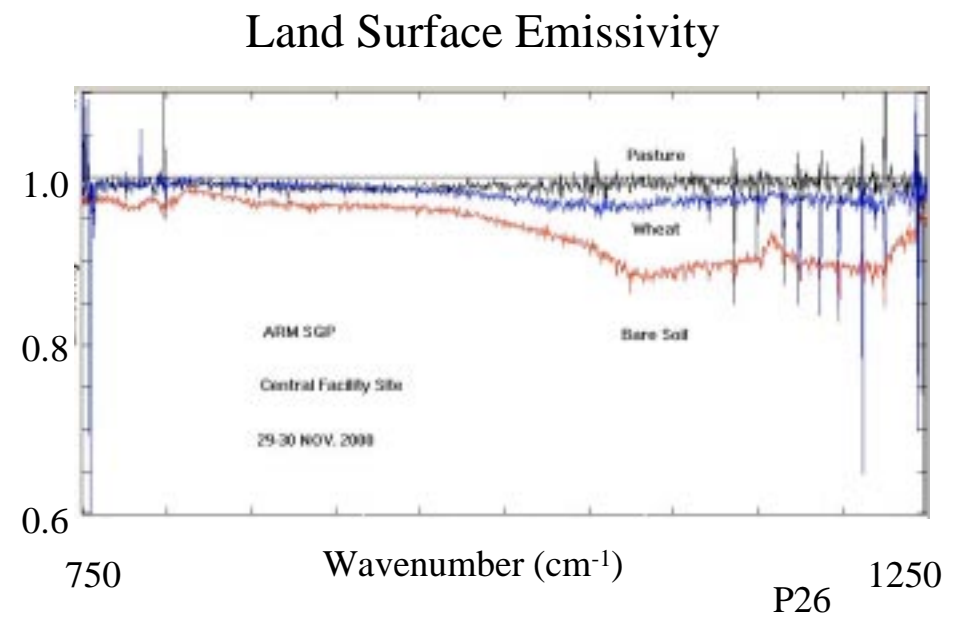
ARM Site Survey 29 Nov. 2000

A survey was conducted to characterize the land type in the vicinity of the ARM Southern Great Plains Central Facility site.



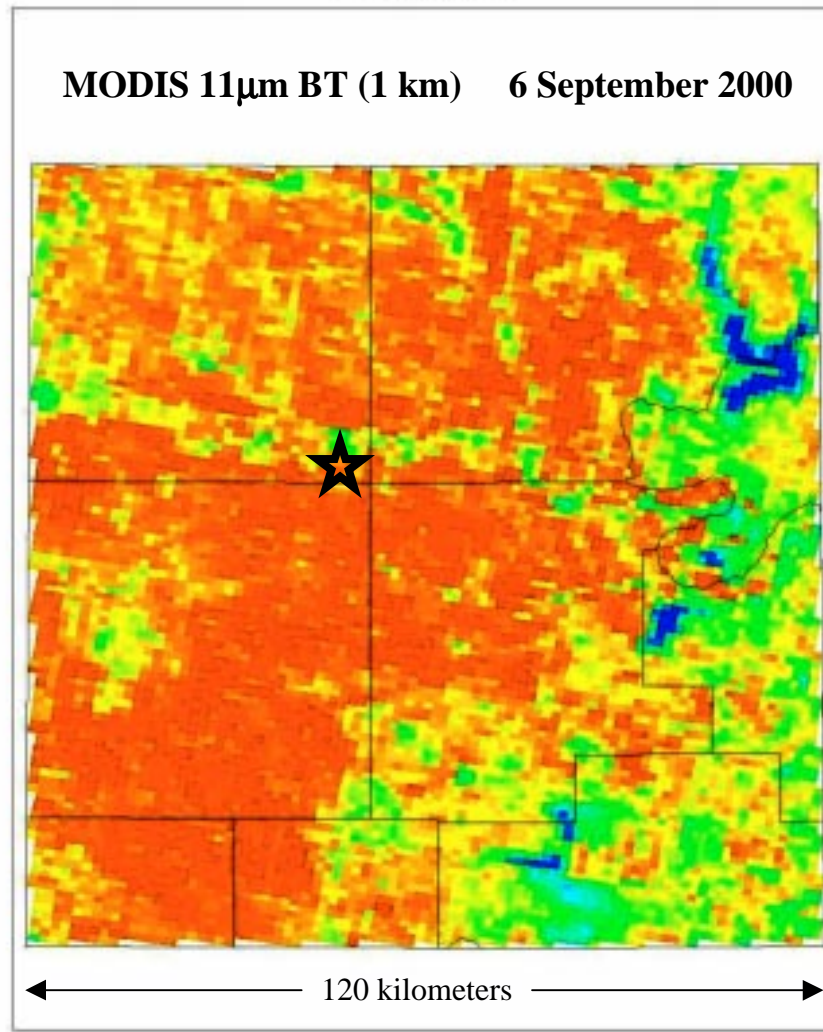
**ARM SGP Central Facility Site:
North-South Survey 29 November 2000**





ARM Land Surface Temperature & Emissivity

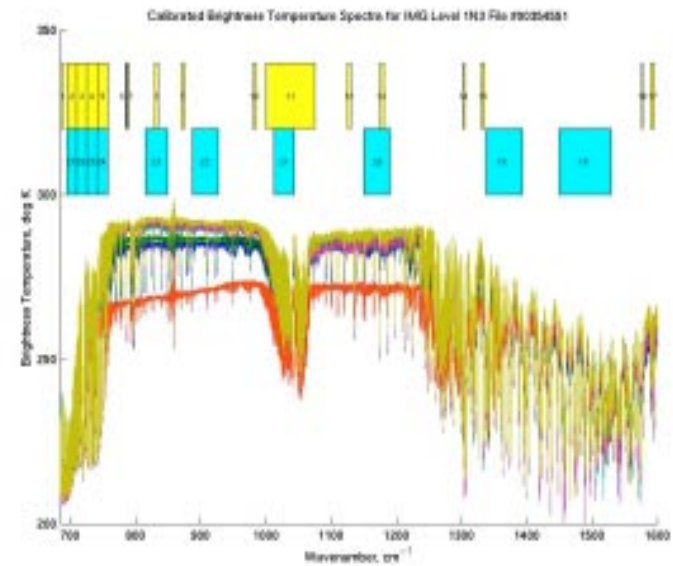
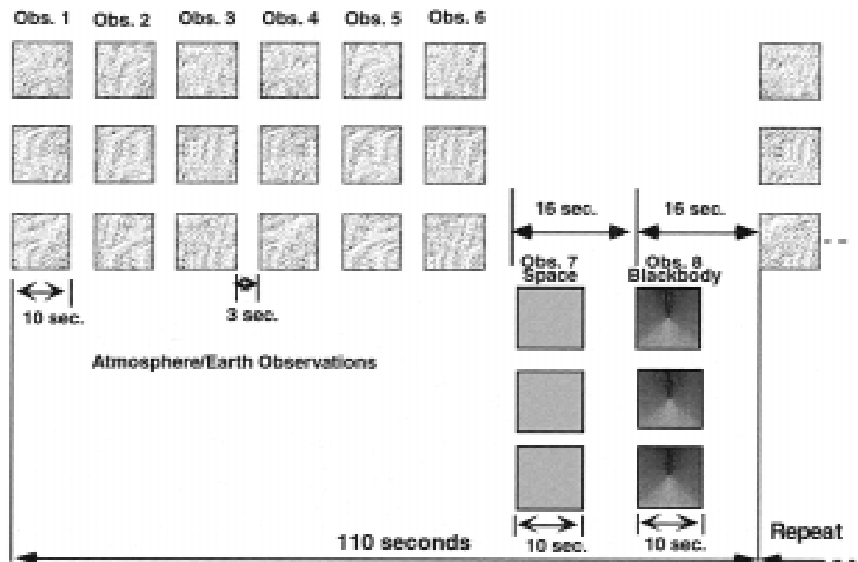
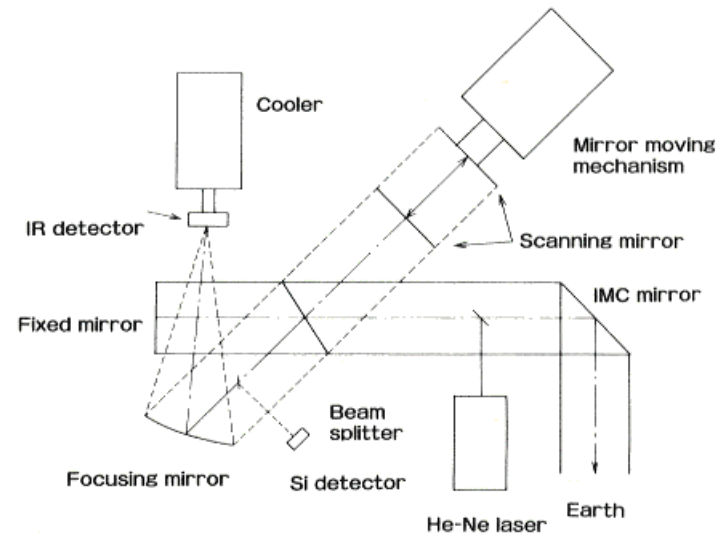
AIRS STM, 20-22 Feb 2001



To Do:

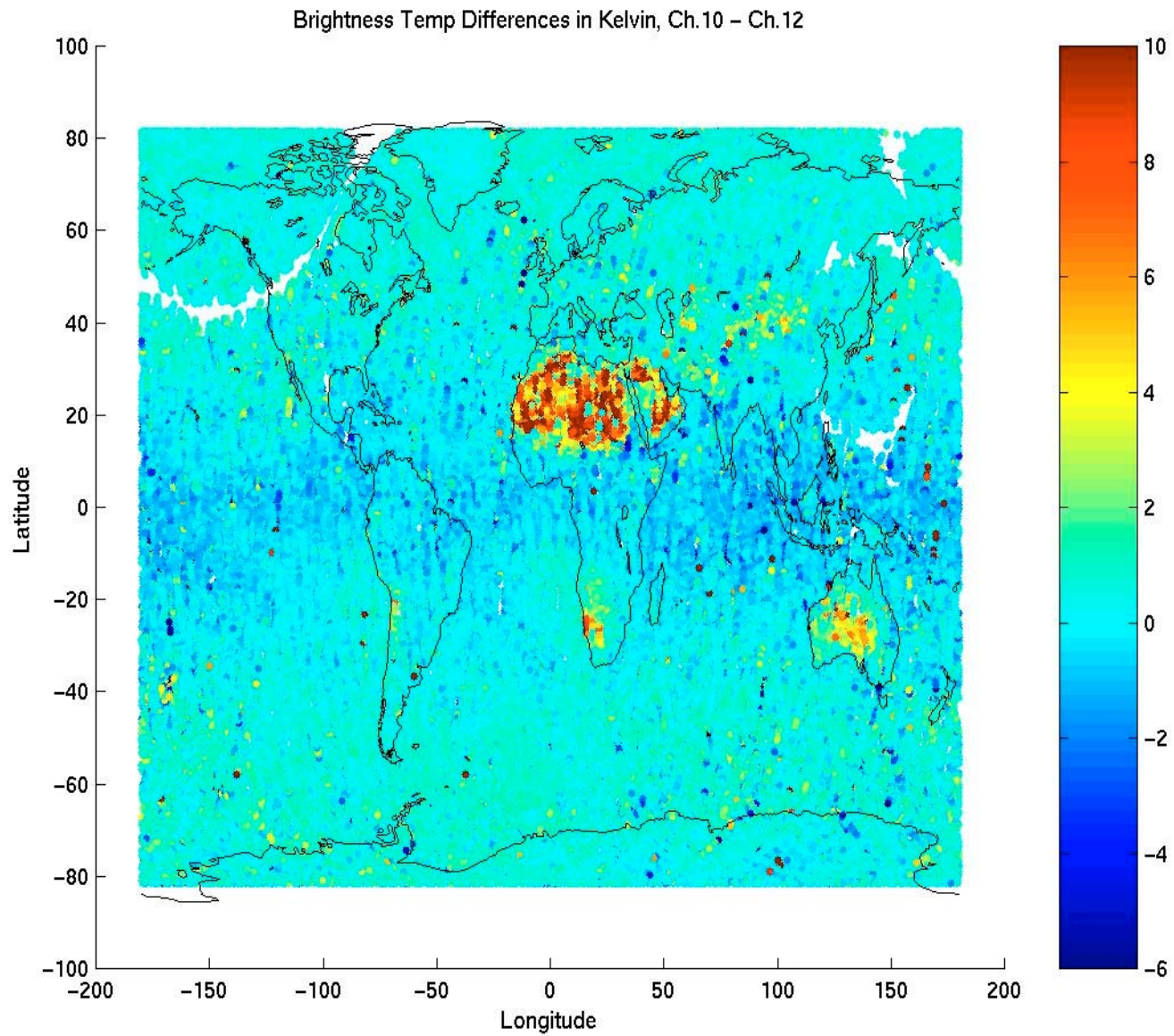
- Develop a model of land surface emission based upon a survey of land types and measured emissivities.
- Use MODIS data to characterize spatial temperature variations
- Use aircraft SHIS & NAST-I data from AFWEX to validate the accuracy of forward model model calculations over the ARM site.

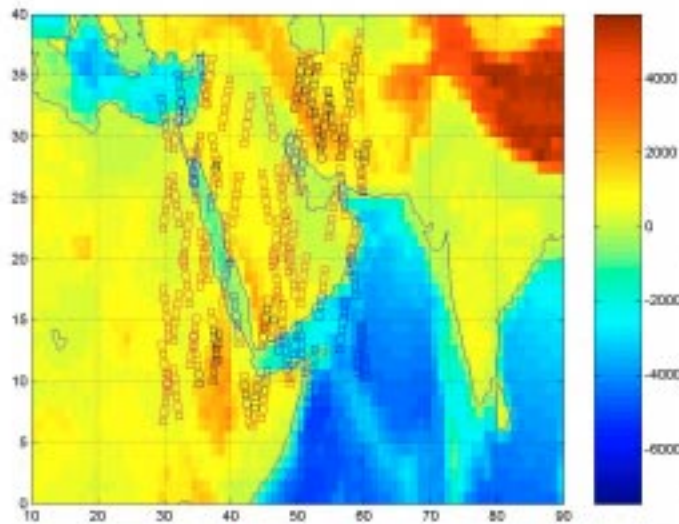
The IMG Instrument



Images from the ERSDAC ADEOS webpage, <http://www.eorc.nasda.go.jp/ADEOS/>

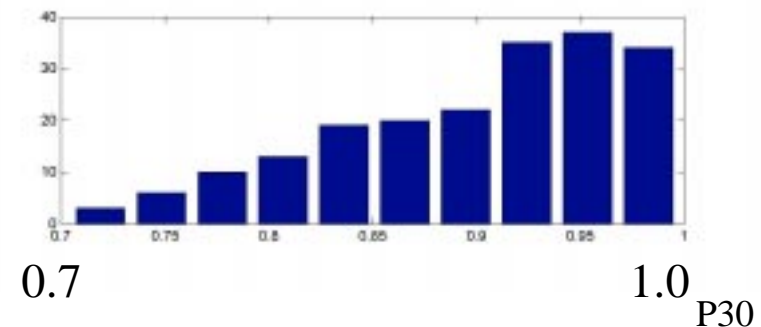
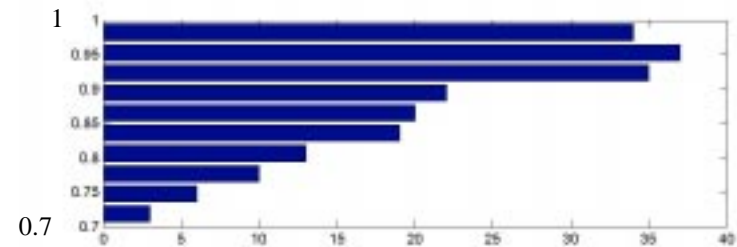
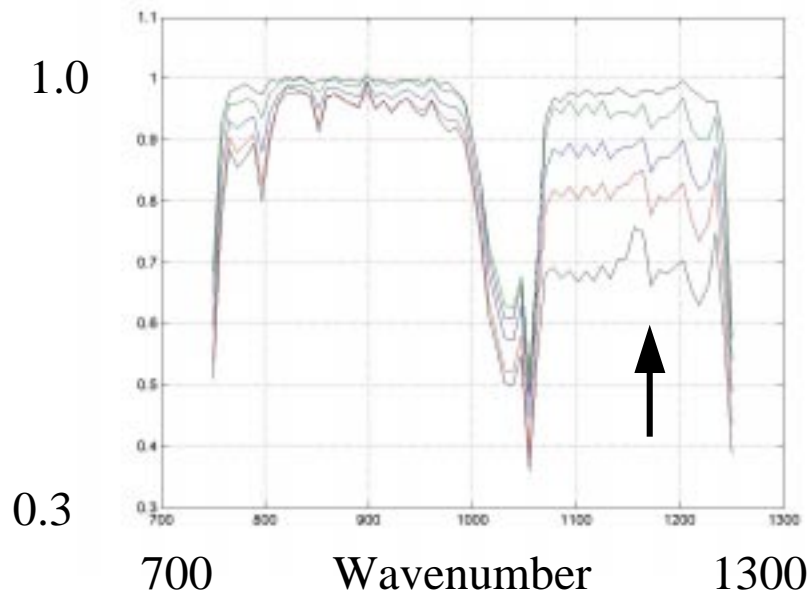
Global Dataset





Regional LSE Characterization

- High spectral resolution permits relative emissivity spectra
- Arabian Peninsula Case Study
 - Mean impact of 10%
 - Distribution of emissivities with range of 30%
- Extensible to other regions.



UW AIRS Validation Activities

To Do (Pre-launch)

- Create upper level H₂O case study from AFWEX and assist Larrabee Strow in spectroscopic analysis.
- Automate ARM Best Estimate atmospheric profile product generation and make available to science team.
- Improve land surface characterization of DOE ARM site for radiance and surface temperature validation.
- Provide science team with a global database of land surface (relative) emissivity from IMG data.